# SCIENCE

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CONTENTS



MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

## *THE RESULT OF THE LAST TWENTY YEARS OF AGRICULTURAL RESEARCH*[1]

I PROPOSE to follow the example of my predecessor of last year, in that the remarks I wish to make to-day have to deal with the history of agriculture. Unlike Mr. Middleton, however, whose survey of the subject went back almost to prehistoric times, I propose to confine myself to the last quarter of a century—a period which covers what I may perhaps be permitted to call the revival of agricultural science.

Twenty-five years ago institutions concerned with the teaching of agriculture or the investigation of agricultural problems were few and far between. I do not propose to waste time in giving an exhaustive list, nor would such a list help me in developing the argument I wish to lay before the section. It will serve my purpose to mention that organized instruction in agriculture and the allied sciences was already at that date being given at the University of Edinburgh and at the Royal Agricultural College, whilst, in addition, one or more old endowments at other universities provided courses of lectures from time to time on subjects related to rural economy. Agricultural research had been in progress for fifty years at the Rothamsted Experimental Station, where the work of Lawes and Gilbert had settled for all time the fundamental principles of crop production. Investigations of a more practical nature had also been commenced by

[1] Section M: Birmingham, 1913. Address of the president to the Agricultural Section of the British Association for the Advancement of Science.

saying that every star in the heavens . . . must have some proper motion," but nevertheless he stoutly insists that for most stars this motion is of negligible amount, because the contrary has not yet been proved.

While the logic thus employed seems somewhat dubious, its quality need not be here too closely scanned. The present state of knowledge concerning stellar proper motions may be described as occupying intermediate ground between the fixity of the faint stars assumed by Burnham and his alternative proposition quoted above, which may be paraphrased into: Every star in the heavens does possess a sensible proper motion. The reviewer will undertake to show elsewhere that, at least down to the thirteenth magnitude, the latter proposition is more nearly true than is Burnham's assumption of fixity for the faint stars. If such be the case, the proper motions derived in this volume can command but little credence; they are quite futile, and the chief value of the work must be sought not in the fulfilment of its professed purposes, but in the furnishing of data from which the motions of the fainter stars may hereafter be derived when those of the brighter stars have been otherwise determined.

The as yet unborn investigator of stellar motions will find in this volume a rich store of material that he must use and will use for this purpose, albeit with writhings of spirit at the scanty information vouchsafed concerning its details, viz.: "These observations have been made in the usual way, fully described heretofore." The reviewer has not been able to find this description. He is left in doubt as to whether "the usual way" refers to observations of close double stars, such as have constituted the bulk of the author's previous work, or whether it implies that those modifications of program have been introduced that are required by the much greater angular distances between the stars here observed. How and with what precision was the parallel determined? How has the small, but troublesome, influence of refraction been dealt with? etc. These are questions that necessarily arise here, although of little consequence in ordinary double-star work. They find no answer in the text and, being unanswered, they must diminish the influence of the work and detract from the credence presumably due to its intrinsic character.

George C. Comstock

## *SCIENTIFIC JOURNALS AND ARTICLES*

The articles in the *American Journal of Science* for October are:

"Distribution of the Active Deposit of Radium in an Electric Field (II.)," E. M. Wellisch.

"Adjustment of the Quartz Spectrograph," C. C. Hutchins.

"Stability Relations of the Silica Minerals," C. N. Fenner.

"Custerite: A New Contact Metamorphic Mineral," J. B. Umpleby, W. T. Schaller and E. S. Larsen.

"Ordovician Outlier at Hyde Manor in Sudbury, Vermont," T. N. Dale.

"Preparation of Tellurous Acid and Copper Ammonium Tellurite," G. O. Oberhelman and P. E. Browning.

"Determination of Water of Crystallization in Sulphates," S. B. Kuzirian.

"Paleozoic Section in Northern Utah," G. B. Richardson.

The September issue of *Terrestrial Magnetism and Atmospheric Electricity* contains the following articles:

"Description of the C. I. W. Combined Magnetometer and Earth Inductor," J. A. Fleming and J. A. Widmer.

"Magnetic Declinations and Chart Corrections Obtained by the *Carnegie* from Port Stanley, Falkland Islands, to St. Helena and Bahia, February to April, 1913," L. A. Bauer and W. J. Peters.

"Magnetic Results of Halley's Expedition, 1698–1700," L. A. Bauer.

"Halley's Observations of the Magnetic Declination, 1698–1700," J. P. Ault and W. F. Wallis.

"On an Auroral Expedition to Bossekop, in the Spring of 1913," C. Störmer.

"Biographical Sketch of William Sutherland," E. F. J. Love.

"Results of Magnetic Observations Made by the United States Coast and Geodetic Survey at the Time of the Solar Eclipse of October 10, 1912," O. H. Tittmann.

Letters to Editor: "Principal Magnetic Storms

Recorded at the Cheltenham Magnetic Observatory," O. H. Tittmann; "The Magnetic Character of the Year 1912," G. van Dijk.

## SPECIAL ARTICLES

### TRANSFORMATION OF GRAVITATIONAL WAVES INTO ETHER VORTICES

ON a number of occasions since 1890, when I first published my electrostatic doublet theory of cohesion, SCIENCE has been so good as to afford me the opportunity of making public the results of my investigations along this and other lines.[1] A brief account of some later work on the origin of vortex systems, accomplished during the past five or six years, may be of interest.

In the above-mentioned series of papers it was shown that all electrical and magnetic phenomena known could be mathematically derived from a system consisting of a single vortex filament in a frictionless fluid, and that gravitation was a compressional elasticity phenomenon in this fluid.

Now this single vortex filament, while satisfactory from the mathematical point of view, so far as all *known* phenomena go, is not equally so if, as we may suspect, the universe is conservative. There is a gap in the cycle. Also, while the single vortex filament appears to be forced upon us by the difficulty of forming any plausible idea of an action which would lead to a filling of the universe with a number of exactly similar vortices, yet if such an action could be formulated it would be more satisfactory, on the ground of probability, than the concept of the single vortex.

While still incomplete, the work above referred to as having been done since 1900, and mostly within the last five years, has given results which are quite satisfactory in regard to both the above-mentioned points. Put briefly, it would appear that gravitational waves shed off a portion of their energy as vortices, and that these vortices are of exactly similar nature irrespective of the intensity of the wave.

In my search for a satisfactory theory to account for the apparently exact similarity of vortex singularities in the ether I came again to Lord Rayleigh's discussion[2] of the difficulty in the equations for the propagation of plane sound waves (which difficulty was first pointed out by Stokes).[3]

According to these equations, the motion of a plane wave becomes after a time discontinuous. Stokes suggested (and Lord Rayleigh considered it probable) that some sort of reflection took place when the motion became discontinuous. Rayleigh also states that divergence would possibly prevent the occurrence of discontinuity, but my work seems to show that there is no beneficial effect caused by divergence; Rayleigh, Taylor and others have pointed out that viscosity would tend to prevent discontinuity.

Some time previously I had done considerable work, in connection with yacht designing, on the discontinuity of flow with the slipping of water along the side of a moving vessel; on the electromagnetic rotation of light in absorbing bodies;[4] and on the reflection of electric oscillations in electric wires with lumped capacity and inductance,[5] all of which work had at some point or other led up to discontinuities, when treated in the regular way, but all of which could be made to give, beyond the point of discontinuity, two part solutions, one part consisting of a diminished flow or wave intensity, and the other of an imaginary part which was interpretable as a vortex, sometimes oscillating, and sometimes conjoined with reflection.

This was at least suggestive, and on a careful examination of the difficulty referred to by Stokes and Lord Rayleigh in the equations for the propagation of plane waves, it was seen that the essential thing necessary to keep the wave from becoming discontinuous was that *it should shed off a certain fractional part of*

[1] "Further Developments of the Electrostatic Doublet Theory of Cohesion," SCIENCE, July 22, 1892, and March 3, 1893; "Determination of the Nature and Velocity of Gravitation," SCIENCE, November 16, 1900, etc.

[2] Rayleigh, "Sound," Vol. 2, p. 35.

[3] *Phil. Mag.*, November, 1848.

[4] *Phys. Rev.*, March, 1900.

[5] U. S. patent 706,738, 1901.